



# April Program Highlights

# NASA Data to Study Pollen Concentration Aids Public Health Tracking

*Jeffrey C. Luvall, Marshall Space Flight Center*

**Highlight:** Pollen source concentrations are dependent on Juniper density, fraction of male trees, time of day, and production of pollen by individual trees. A completed critical step was in determining pollen source concentrations for input into Pollen Regional Atmospheric Model (PREAM), and this step allows for the generation of pollen concentration surfaces and the transport of the pollen. These pollen concentration surfaces are ingested into a delivery system for integrating pollen forecasts into the New Mexico Environmental Public Health Tracking (NMEPHT) and Syndrome Reporting Information System (SYRIS), providing health alerts to the community. Our metric is to be able to observe pollen transport for a 36-48 hour time period and compare model predicted peak pollen counts with ground-based measurements.

**Relevance:** Asthma is a chronic inflammatory disorder of the lungs. In New Mexico, the Albuquerque Public School system maintains an asthma registry for the K-6 population that currently identifies more than 2000 individuals. While the pollen calendars for juniper and other species are known in broad outline, an ability to provide daily pollen alerts between February and June would greatly improve decisions about health interventions for this group (e.g. stay home; stay indoors; avoid strenuous outdoor activities; etc.). Asthma is among the diseases contributing to Chronic Obstructive Pulmonary Disease (COPD), and cumulative air quality conditions ultimately exposes the entire population to compounding respiratory health threats.

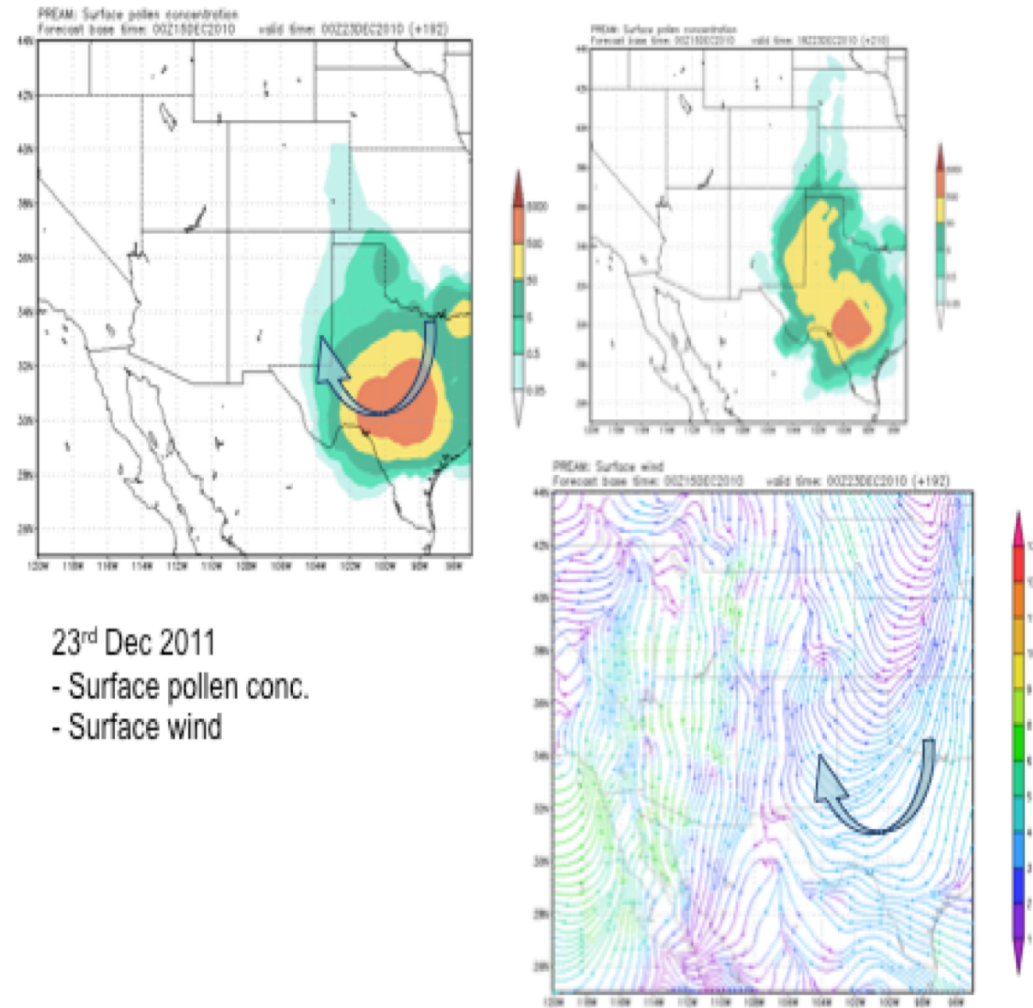


Figure1. Wind fields and surface pollen concentrations used in PREAM runs. Direction of pollen transport varies greatly depending on these pressure gradients.

**Project Summary:** Reports of *Juniperus* spp. pollen transported 200-600 km have been documented. Hence local observations of plant phenology may not be consistent with the timing and source of pollen collected by pollen sampling instruments. The DREAM (Dust REgional Atmospheric Model) is a verified model for atmospheric dust transport modeling using MODIS data products to identify source regions and quantities of dust. We are modifying the DREAM model (PREAM) to incorporate Pollen transport. Pollen release will be estimated based on MODIS derived phenology of *Juniperus* spp. communities. Ground based observational records of pollen release timing and quantities will be used as verification. This information will be used to support the Centers for Disease Control and Prevention's National Environmental Public Health Tracking Program and the State of New Mexico environmental public health decision support for asthma and allergies alerts.

**Earth Science Products:** NASA MODIS - NDVI, EVI, MOD09

**Technical Description of the Images:** Figure 1 - Regional meteorological conditions greatly influence the direction the pollen will travel. Pollen can be vectored in any direction depending on the location of the pressure gradients. The initial PREAM runs are reflecting the timing variability in pollen concentration sampled by the ground based Burkard samplers are several sampling sites.

**Application to Decision Making:** The pollen module in EPHTS will be used to: (1) support public health decisions for asthma and allergy alerts in New Mexico, Texas and Oklahoma; (2) augment the Centers for Disease Control and Prevention (CDC)'s Environmental Public Health Tracking Network (EPHTN); and (3) extend surveillance services to local healthcare providers subscribing to the Syndrome Reporting Information System (SYRIS).

**Scientific Heritage:** Current work can be linked back to NASA funded Rapid Prototyping Capability Proposal For Environmental Factors Affecting Asthma and Allergies Public Health, NASA/REASoN-sponsored Public Health Applications in Remote Sensing (PHAIRS) Surveillance Project (PHAIRS), partnering with Universities of New Mexico & Arizona.

**References:** Morain, S.A. and A.M. Budge. 2006. Science Data Products for Public Health Decision Support. In: Proceedings of Geoscience and Remote Sensing Symposium, IEEE International Conference. 31 July – 04 August. Pages 421-424. DOI: 10.1109/IGARSS.2006.112.

Yin, D., Nickovic, S., Barbaris, B., Chandy, B., and W.A. Sprigg. 2005. Modeling Wind-blown Desert Dust in the Southwestern United States for Public Health Warning: A Case Study. Atmospheric Environment, DOI:10.1016/j.atmosenv.2005.07.009.

\*Estelle Levetin, Univ. of Tulsa, Amy Budge, Univ. of NM, Peter Van de Water CA State Univ, Fresno and others.

# NAAPS and NASA Satellite Data Used by NOAA to Study Sahara Dust Impact on Texas AQ

*P.I., D. Westphal, Monterey, CA*

**Highlight:** The summer-time transport of Sahara dust to the Southeastern US has episodic impact on the concentration of ambient particulate matter (PM). From an Air Quality (AQ) management perspective, Sahara dust plumes are 'exceptional events' that need to be quantified and documented. The Navy Aerosol Analysis and Prediction System (NAAPS) model that incorporates NASA's satellite observations can forecast and quantify the impact of such dust events. NOAA scientists are using the NAAPS model simulations along with their own dust measurements from a research ship in the Gulf of Mexico to characterize several Sahara dust events during 2006. The combination of these observations and tools are helping NOAA scientist to estimate with confidence the magnitude of the Sahara contribution to PM in Texas.

**Relevance:** The main contribution of this project to the Sahara dust impact study is the full 4-dimensional characterization of the dust concentration field. As indicated in the image, over the ocean, the bulk of the dust is in an elevated layer well above the marine boundary layer. When the dust reaches the land, the dust layer descends and it is mixed to the ground and increases the surface PM concentration. This is then evidence that Sahara dust impacts on Texas air quality. Events such as Sahara dust intrusions require detailed documentation by the State agencies. Specifically they are required to provide evidence that the source of high concentrations are beyond their jurisdiction.

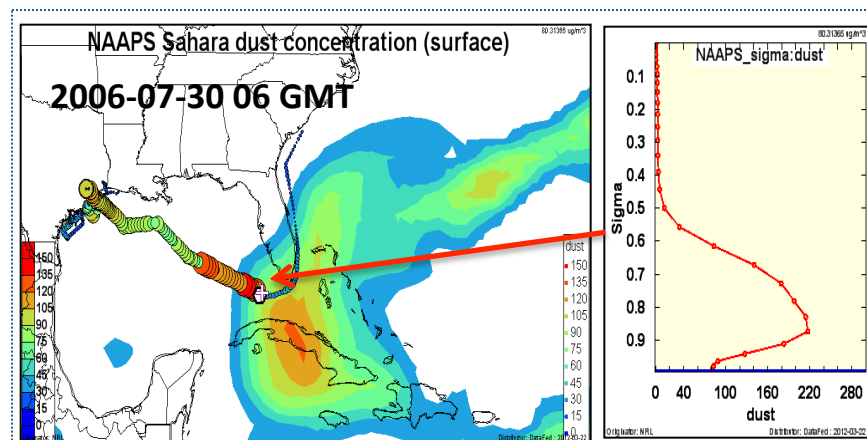


Figure 1. Contours of modeled dust concentration at the surface and vertical dust profile as the NOAA research ship passed the Florida Keys. Note that the dust layer is elevated.

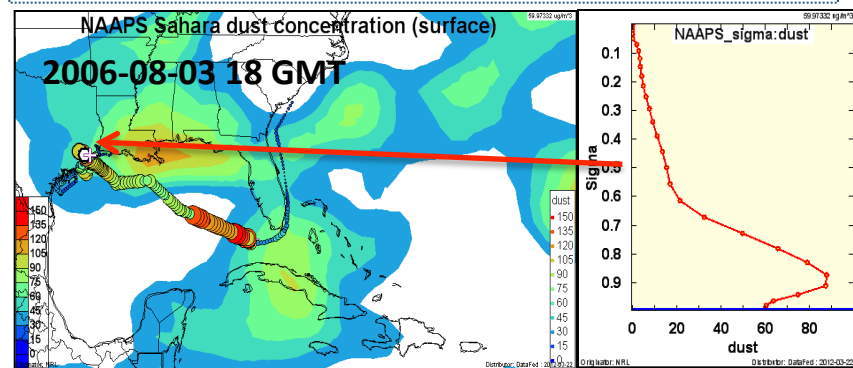


Figure 2. Dust concentration and vertical profile as the ship docked at Houston, TX. Evidently the dust layer has subsided and became entrained in the mixing layer over land, adding to the particulate matter contributed by local sources.

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**Project Summary:** The project will make NASA products available to the AQ community via the aerosol analyses and forecasts of the Navy Aerosol Analysis and Prediction System (NAAPS) and served to the community via Visibility Information Exchange Web System (VIEWS) and DataFed Data Support Systems. This project provided a full year of NAAPS dust transport simulations and custom data extractions to the NOAA science team.

**Earth Science Products:** NAAPS utilizes the following NASA products for sources, initialization, and sinks: MODIS AOD; MISR-derived height, composition and AOD; MODIS and GOES fire detection; CALIPSO heights of aerosol layers; MODIS Deep Blue AOD; MODIS Dust Enhancement Product (NRL); and TRMM.

**Technical Description of the Images:** These images shows data fusion: NAAPS model, assimilating satellite data, and compared to ship-based surface observations. In DataFed, data system, the NAAPS surface concentrations were extracted for the entire trajectory of the ship, so that the model and the ship-based measurements can be directly correlated.

**Application to Decision Making:** This project supports air quality management in Texas. Exceptional Events such as Sahara dust intrusions require detailed documentation by the State agencies. Specifically they are required to provide evidence that the source of high concentrations are beyond their jurisdiction. This project is supporting both the NOAA science team and the Texas Commission on Environmental Quality by providing compelling evidence for Sahara dust events and also evaluating the frequency of such events. Based on the favorable outcome of the 2006 analyses, NOAA has requested additional NAAPS data to cover a 5-year period 2006-2011. Discussions are in progress with EPA and some States to use the NAAPS dust forecasts and impact analyses routinely.

**Scientific Heritage:** The NAAPS model has been made possible by funding from Navy and NASA sources. NASA funding has been instrumental in the development of FLAMBE (smoke source term), MODIS QC/QA (data assimilation of AOD), MISR (MODIS comparison), TRMM (scavenging studies), and AERONET (for validation and QC/QA).

The federated data system, DataFed at Washington University was partially funded by a NASA Reason Grant during 2004-2009. DataFed was used extensively in the development of EPA's Exceptional Even rule and also in performing a range of Exceptional event analyses for EPA.

**References:** 2011, Westphal, D. L., R. B. Husar, S. E. McClure, W. Eberhard, J. R. Campbell, E. J. Hyer, J. S. Reid, W. R. Sessions, and J. Zhang, Saharan dust analyses and forecasts for the Americas. Presented at the IGAC First International Workshop on the Long-Range Transport and Impacts of African Dust on the Americas, October 6-7, 2011 San Juan, Puerto Rico.

# MODIS Data Products Support Mosquito Habitat Modeling in Eastern Mexico

William Crosson, Universities Space Research Association, Marshall Space Flight Center

**Highlight:** Mosquito, *Aedes Aegypti*, is the primary transmitter of Dengue Viruses in the world. Several remotely-sensed data sets have been compiled in support of the NASA/Center for Disease Control (CDC) project examining the relationships between the environment and habitat areas of the mosquito *Aedes Aegypti* in Mexico. These data are being used to develop mosquito habitat models that can be applied in this or other regions based solely on remotely-sensed data.

**Relevance:** Dengue Fever is caused by one of four viruses carried by mosquitoes in tropical and subtropical areas. Cases have increased dramatically in the past few decades; there are currently ~100 million infections annually around the globe. Little is known about the environment limits of the habitat of the disease vector, *Aedes Aegypti*. Our project will integrate environmental observations, including weather, land use, vegetation type, amount and greenness, soil moisture, and mosquito populations with investigations of the human dynamics of the system via household surveys.

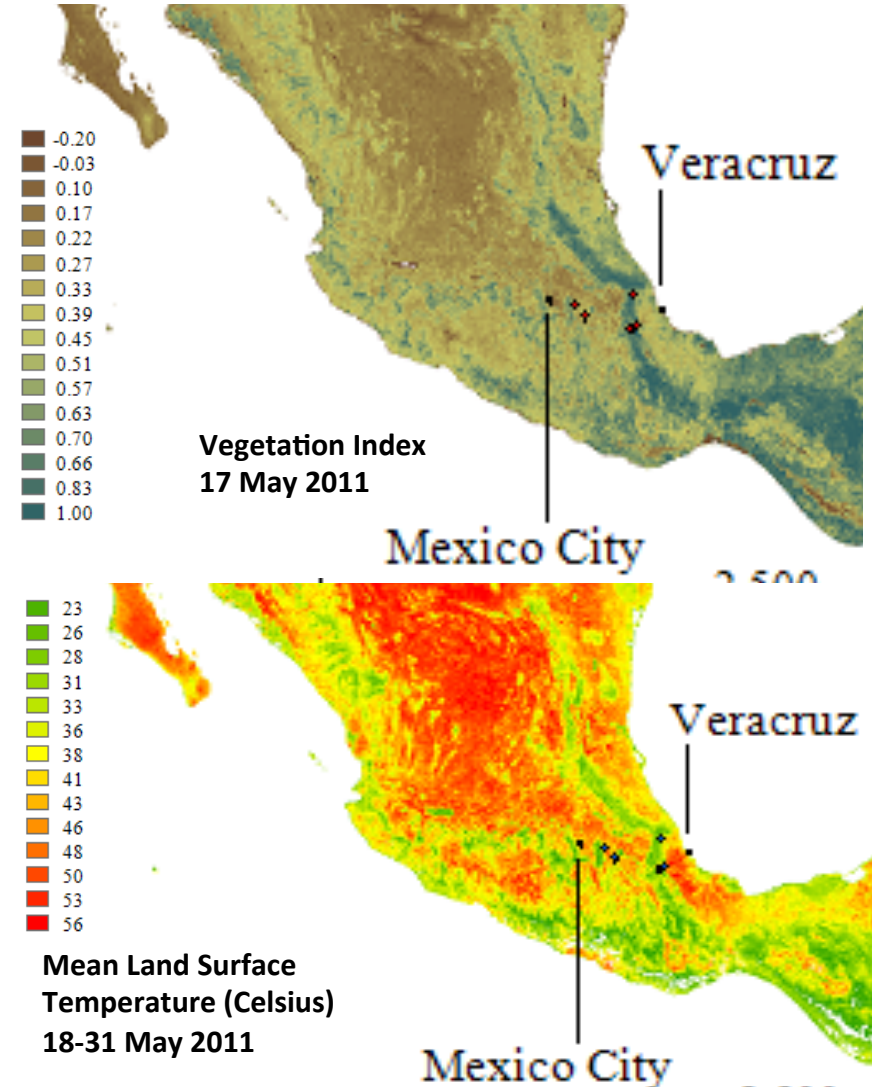


Figure 1: Examples of two MODIS data sets developed for the project. Top: Normalized Difference Vegetation Index (NDVI), Bottom: Mean 14-day land surface temperature.



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**Project Summary:** This work facilitates collaborative interaction among University Space Research Association (USRA), NASA, NCAR, CDC and the University of Veracruz, Mexico, to monitor and model the social, economic, environmental, and epidemiological factors that control the survival and abundance of the mosquito vector *Aedes aegypti*, the primary transmitter of dengue viruses. The ultimate goal is to employ this integrated approach toward understanding the potential expand the range of *Aedes aegypti* toward heavily populated high elevation areas such as Mexico City, under various climate change and socio-economic scenarios.

**Earth Science Products:** The following MODIS data products have been obtained and extractions made for the Mexico study area for the period of January – October 2011:

Land Surface Temperature (LST) for day and night from Aqua (product MYD11A1) and Terra (product MOD11A1).

16-day Normalized Difference Vegetation Index (NDVI): With a 250 m resolution, the NDVI product (MOD13Q1) is a sixteen-day average derived by the ratio of the reflectance of red and near infrared spectral bands.

Land Cover/Land Use type: The MOD12Q1 product describes 17 land cover classes derived from an entire year of Terra observations. The scheme identifies LCLU classes defined by the International Geosphere Biosphere Programme (IGBP).

**Technical Description of the Images:** The top panel shows MODIS 16-day NDVI for May 17, 2011, with values ranging from near zero for bare surfaces to near 1 for dense, green vegetation. The bottom panel illustrates the 16-day mean LST for the same time period. Values range from around 20° to greater than 50° Celsius.

**Application to Decision Making:** Our end-user partners at CDC are interested in surveillance methods using remote sensing and other data sets that are available routinely in near-real time. If such systems can be developed and prove reliable, CDC and in-country public health officials will be able to determine the spatial and temporal locations of disease vectors and thus anticipate outbreaks of diseases such as Dengue Fever.

**Scientific Heritage:** CDC, NCAR and U of Veracruz were initially funded by the Dynamics of Coupled Natural and Human Systems program of the National Science Foundation (NSF) to investigate and model the social, economic, environmental, and epidemiological factors that control the survival and abundance of *Aedes aegypti*. That project is quantifying natural factors (annual and monthly temperature, humidity, rainfall) and human factors that potentially limit mosquito populations in the study communities.

# Towards an Integrated Soil Moisture Drought Monitor for East Africa

*Weston Anderson & Ben Zaitchik (Johns Hopkins University),*

*Chris Hain (NOAA NESDIS), Martha Anderson & M. Tugrul Yilmaz (USDA-ARS),*

*John Mecikalski & Lori Schultz (University of Alabama, Huntsville)*

**Highlight:** Scientists at Johns Hopkins University, NOAA, USDA, and the University of Alabama, working under *NASA Project Nile* (PI: B. Zaitchik, JHU), have generated a prototype soil moisture drought monitor based on objective merging of multiple independent soil moisture estimates. In this pilot study, soil moisture anomalies derived from microwave remote sensing (AMSR-E), thermal remote sensing (Meteosat LST, analyzed using the USDA Atmosphere Land Exchange Inverse (ALEXI) model), and a prognostic land surface model (Noah LSM) were combined using a technique that weights each estimate on the basis of relative agreement. The resulting soil moisture anomaly maps (Figure 1) offer spatially complete analysis of the 2010-2011 Horn of Africa drought that is grounded in multiple independent methodologies.

**Relevance:** Drought in East Africa is a recurring phenomenon with significant humanitarian impacts. Given the steep climatic gradients, topographic contrasts, general data scarcity, and, in places, political instability that characterize the region, there is a need for spatially distributed, remotely derived monitoring systems to inform national and international drought response. At the same time, the very diversity and data scarcity that necessitate remote monitoring also make it difficult to evaluate the reliability of these systems. By merging multiple, independent products, the technique applied in this study allows for confidence in soil moisture anomaly estimates in the absence of ground data.

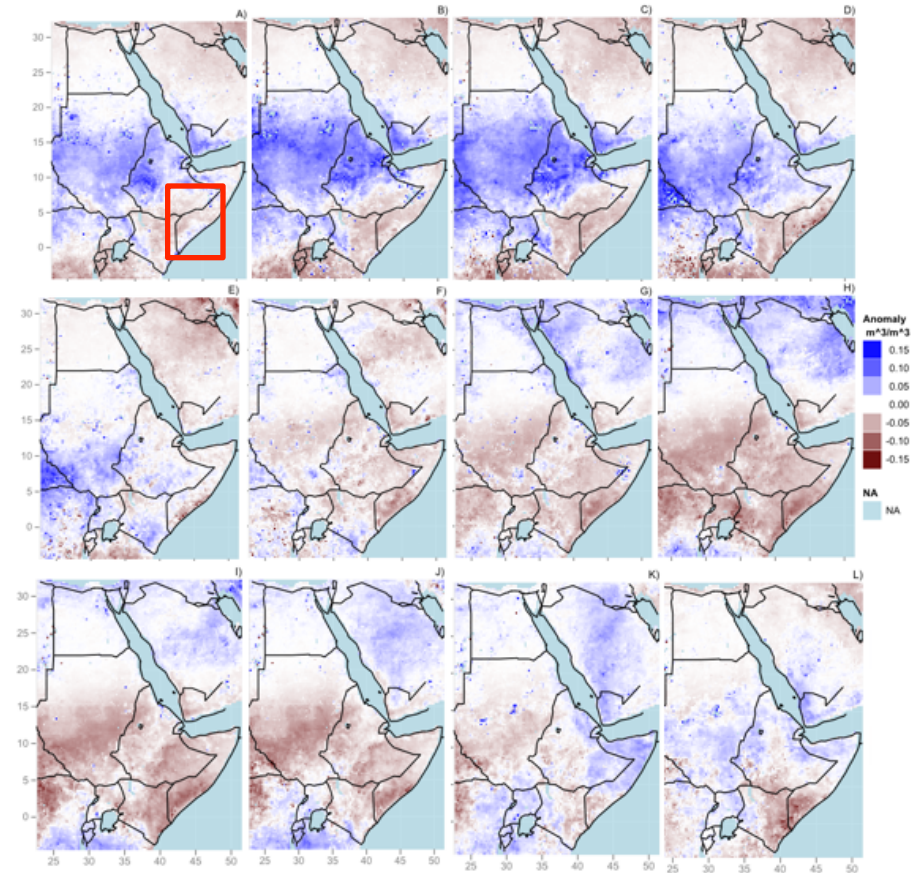


Figure 1. Monthly anomaly maps of the progression of the 2010-2011 Horn of Africa drought using the Triple Collocation Analysis merged product. July – December 2010 (A-F) and January – June 2011 (G – L). The core drought affected area is indicated in (A).



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**Project Summary:** *NASA's Project Nile* is designed to provide improved hydrometeorological information and climate analysis to the nations that share the Nile basin. The integrated soil moisture drought monitoring study presented here is a demonstration of the value that satellite and model-based hydrometeorological monitoring can provide in this data sparse region.

**Earth Science Products:** This results presented here make use of microwave-based soil moisture estimates from AMSR-E, Meteosat Second Generation (MSG) surface temperature estimates, and TRMM Multisensor Precipitation Analysis (TMPA) 3-hourly precipitation rate estimates. MODIS Normalized Difference Vegetation Index (NDVI) and GRACE terrestrial water storage anomaly estimates were also used in other aspects of the analysis.

**Technical Description of the Images:** Soil moisture anomalies presented in the figure represent the Triple Collocation Analysis weighted composite of AMSR-E, MSG-ALEXI, and Noah Land Surface Model root zone soil moisture anomaly estimates. Weights are determined on the basis of relative agreement between estimates. In areas where one of the three observations is missing or questionable, the two remaining products are merged at equal weight.

**Application to Decision Making:** Remote sensing and physically-based models are critically important methods for monitoring drought in areas with limited in situ observation networks, particularly for countries with food security concerns. As shown in this study, remotely sensed observations are valuable for their spatial and temporal continuity as well as for their diversity—satellite-derived observations of precipitation, soil moisture, vegetation condition and terrestrial water storage offer a range of information on meteorological, agricultural, and hydrological drought over space and time. This diversity of information is valuable for tracking the progression and severity of a drought and for anticipating the impacts that an emerging drought may have on ecological and human systems.

**Scientific Heritage:** The study owes a debt to extensive work performed in the development of Noah Land Surface Model, the Land Information System (LIS) modeling framework, TRMM precipitation products, ALEXI soil moisture algorithms, and AMSR-E retrieval and soil moisture estimation algorithms. The work also derives directly from the development of Triple Collocation Analysis (Scipal et al., 2007) and its application to soil moisture anomalies in the United States (Hain et al., 2011).

#### References:

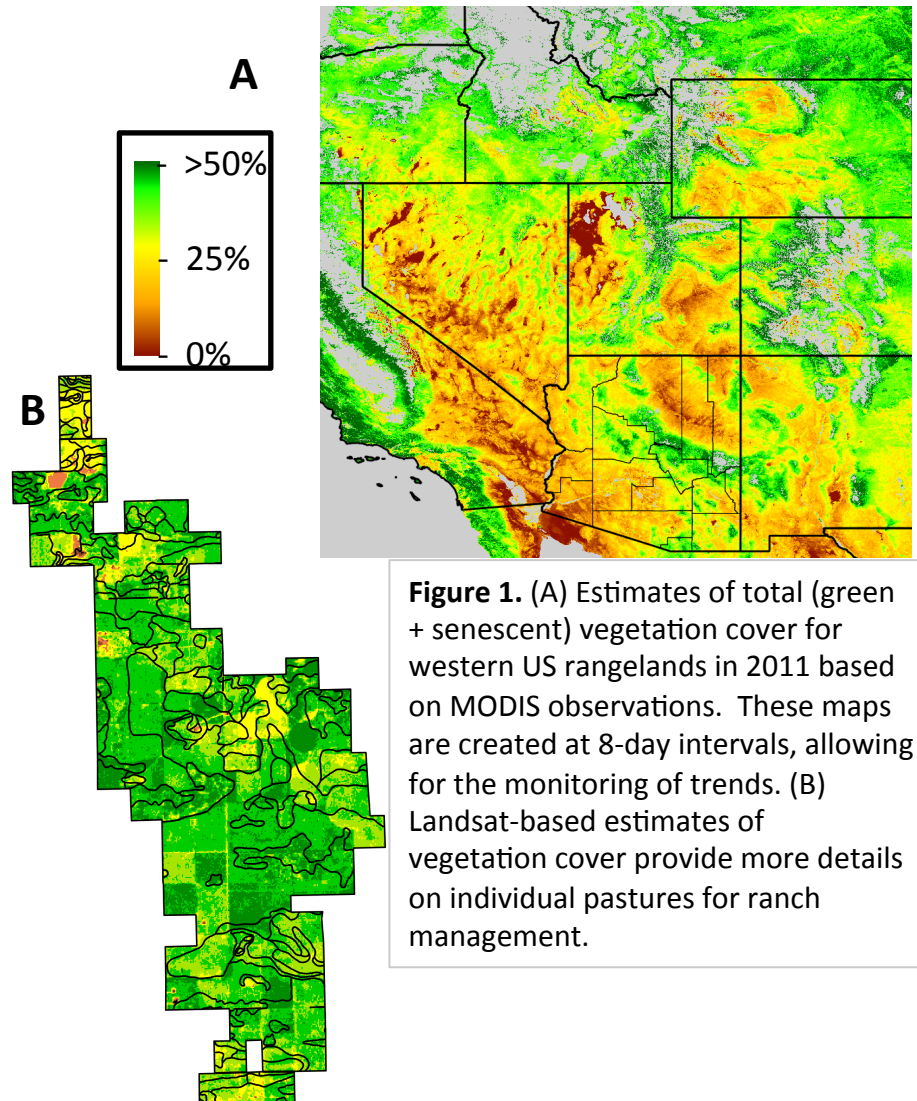
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- Scipal, K., T. Holmes, R. de Jeu, V. Naeimi and W. Wagner, A possible solution for the problem of estimating the error structure of global soil moisture data sets. *Geophys. Res. Lett.*, 35, L24 403, 2008.
- Hain, C.R., W.T. Crow, J.R. Mecikalski, M.C. Anderson and T. Holmes, An Intercomparison of Available Soil Moisture Estimates from Thermal-Infrared and Passive Microwave Remote Sensing and Land-surface Modeling. *JGR*, 116, D15107. 2011.

# Incorporation of Grassland Canopy Cover Estimates Derived from MODIS Observations and a Web-Based Geospatial Data Delivery Tool Improve the Decision Making Process at the USDA

Stephen Hagen/Applied GeoSolutions

**Highlight:** A system that uses NASA data to map and monitor total vegetation cover in grasslands has been developed by scientists and government conservationists at Applied GeoSolutions, Michigan State University, the Southwest Watershed Research Center, US Department of Agriculture-Agricultural Research Service (USDA-ARS), and the USDA National Resource Conservation Service (NRCS) in Arizona and New Mexico. The maps derived from MODIS and Landsat are sensitive to both green and senescent vegetation, allowing land managers to understand changes to rangelands. The vegetation cover maps are combined with precipitation and temperature maps to provide rangeland managers insight into management issues on individual ranches. This decision support tool is used by rangeland conservationists in the state and field offices to efficiently deploy the most valuable resources – the field conservationists that assist ranchers.

**Relevance:** Field estimates of rangeland vegetation condition are the gold standard for making decisions regarding the conservation of rangelands. Yet these observations are expensive to collect and limited in spatial and temporal coverage. By using spatially and temporally complete products from combined field and satellite-based observations, the NRCS can make better and more efficient management decisions.



**Figure 1.** (A) Estimates of total (green + senescent) vegetation cover for western US rangelands in 2011 based on MODIS observations. These maps are created at 8-day intervals, allowing for the monitoring of trends. (B) Landsat-based estimates of vegetation cover provide more details on individual pastures for ranch management.

## **Stephen Hagen, Applied GeoSolutions**

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**Project Summary:** Our project goal is to deploy a system that will utilize observations from NASA's MODIS sensor to enhance the existing rangeland conservation decision making process at USDA-NRCS in Arizona and New Mexico.

**Earth Science Products:** This project provides estimates of Total Vegetation Fractional Cover (TVFC) and Green Fractional Cover (GFC) every eight days across the grasslands in the southwest. These estimates are generated from well-established algorithms applied to MODIS surface reflectance data. The TVFC algorithms utilize surface reflectance in the two shortwave infrared bands and the red band, and are sensitive to both green and senescent vegetation, while differences in the soil background are minimized. The GFC estimates are derived from the normalized difference vegetation index (NDVI). The satellite-based estimates of cover are delivered as part of a larger web-based Rangeland Decision Support System that also provides information on precipitation patterns, soil conditions, and topography.

**Technical Description of the Images: Figure 1.** (A) Estimates of total (green + senescent) vegetation cover for western US rangelands in 2011 based on MODIS observations. These maps are created at 8-day intervals, allowing for the monitoring of trends. (B) Landsat-based estimates of vegetation cover provide more details on individual pastures for ranch management.

**Application to Decision Making:** A large function of the state NRCS office is to efficiently allocate Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP) funding from the national level to individual land owners for conservation. These programs are voluntary and the NRCS offers financial and technical assistance to land owners. Requests for assistance from the EQIP program exceed available funds, so the NRCS is tasked with ranking applicants to decide how to most effectively and efficiently allocate funds. The NRCS visits applicant sites and conducts measurements on rangeland condition. Conducting these site visits is expensive and time consuming. A reasonable inventory on a 20,000 acre ranch takes up to 2 weeks. Many ranches exceed 100,000 acres in size. Satellite-based estimates of vegetation cover from our system make these visit significantly more efficient, saving the NRCS money and allowing better decisions.

**Scientific Heritage:** NASA Small Business Innovative Research (SBIR) funded Prototype Rangeland Decision Support System in Arizona.

# Mapping and Monitoring Nuisance Submerged Aquatic Vegetation (SAV) in the Great Lakes

Robert Shuchman, Michigan Tech Research Institute

**Highlight:** An algorithm was developed to map Submerged Aquatic Vegetation (SAV) in the US Great Lakes using multiple sources of satellite imagery under a NASA ROSES Feasibility grant. Data sources have included Landsat, MODIS, MERIS, and commercial satellite imagery from 2009-2011. These imagery have made it possible to apply the Michigan Tech Research Institute's (MTRI) depth-correction algorithm to analyzing the patterns and locations of SAV (see examples figures at right) as well as estimating biomass. In Lake Michigan, SAV is predominantly the nuisance algae *Cladophora*, with localized areas of macrophytes, *Chara*, and diatoms.

**Relevance:** *Cladophora* algae causes beach fouling and has become a more prominent problem in recent years. The US Environmental Protection Agency (EPA) wanted to establish a baseline of nuisance SAV extent in the Great Lakes and awarded a grant to the MTRI-led team through the Great Lakes Restoration Initiative (GLRI) to create maps of current SAV extent. The SAV maps are being used as part of the State of the Lake Ecosystem (SOLEC) monitoring process to help understand how federal funding is helping restore the ecosystems of the Great Lakes. NASA funding led directly to this operational algorithm benefiting restoration.

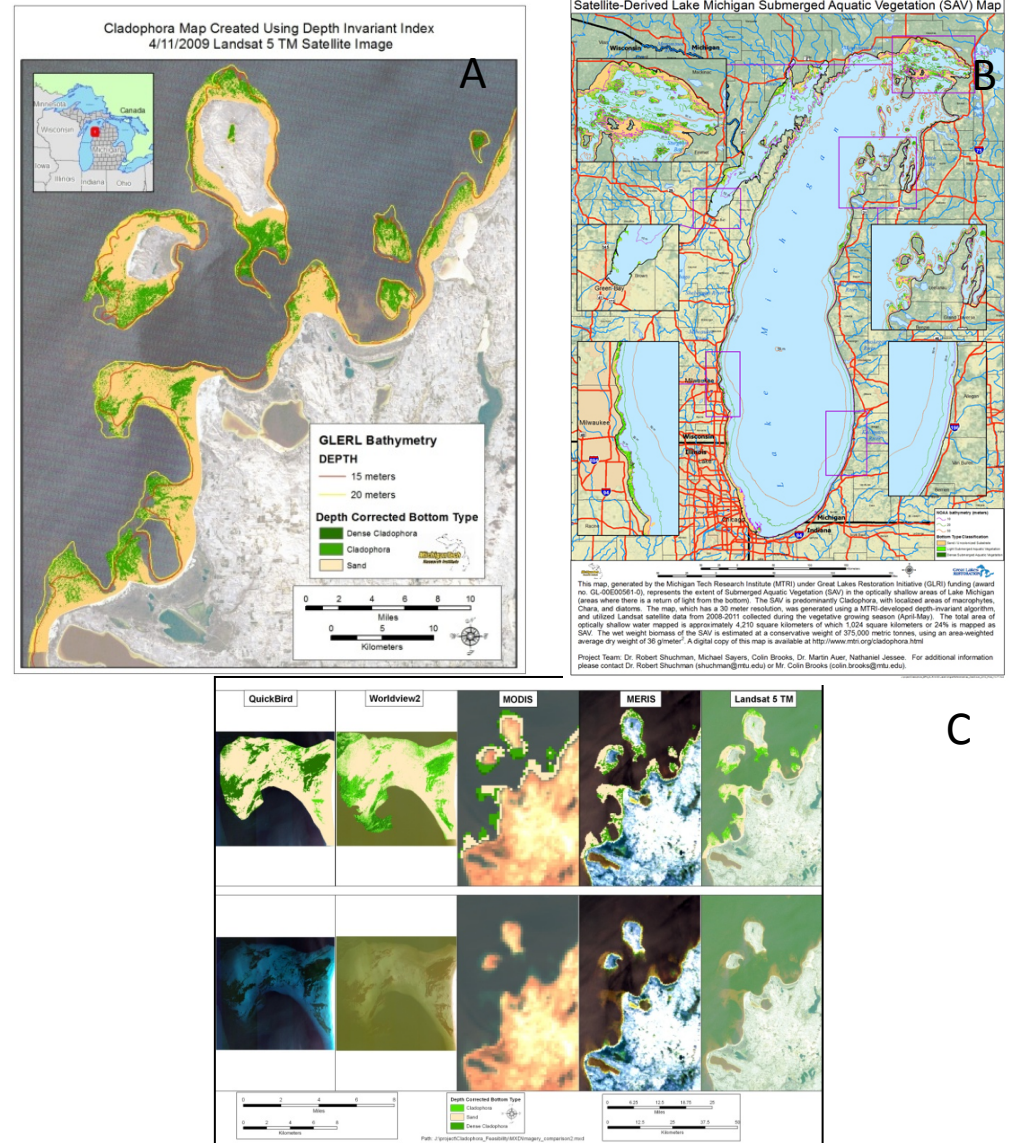


Figure 1: Examples of SAV maps derived from satellite data sources using MTRI's algorithm to show- A: depth variance, B: A Larger derived regional map, and C: data sources over the same studied area of the lake.



## **Dr. Robert Shuchman, MTRI Co-Director**

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**Project Summary:** The goal of the NASA ROSES Feasibility grant was to test the capability of multi-source satellite imagery to rapidly and accurately map the extent of Submerged Aquatic Vegetation (SAV), especially the nuisance *Cladophora* algae, for the lower four US Great Lakes (Lakes Michigan, Huron, Erie, and Ontario). A depth-correction algorithm was successfully developed and was used on an operational basis to map SAV extent for the US EPA for monitoring the success of Great Lakes restoration initiatives. Biomass and lake clarity trends have also been derived.

**Earth Science Products:** Landsat 5 TM satellite imagery formed the main data source for the SAV mapping due to its 30m spatial resolution, free availability, and large synoptic archive of the Great Lakes. Certain high-priority areas such as Sleeping Bear Dunes National Lakeshore were mapped at 2m resolution using commercial satellite imagery such as WorldView-2, GeoEye-1, and Quickbird. Demonstrations of mapping with MERIS and MODIS have also been shown to be useful where their resolutions produce sufficient detail.

**Technical Description of the Images:** SAV extent maps were derived by utilizing deep water (opaque) water radiance values to correct shallow water values (transparent) so that depth-invariant reflectance values for all 3 visible Landsat bands of the lake bottom could be used to classify lake-bottom type; combinations of 2 bands were used to generate a depth-invariant bottom-type index. SAV extent is calculated by thresholding the depth-invariant reflectance values. Biomass is estimated through correlating reflectance values to field-sampled dry weights.

**Application to Decision Making:** The US EPA is using the SAV-extent maps as part of its efforts to monitor the impacts of the Great Lakes Restoration Initiative (GLRI) and related efforts by using them as a baseline. The maps are the first time that SAV, which is mostly nuisance *Cladophora* algae, have been available for the lower four Great Lakes and are being made available through <http://www.mtri.org/cladophora.html>

**Scientific Heritage:** MTRI's algorithm builds from the methods of Lyzenga; MTRI's updated analysis makes them available for mapping of bottom types for all the shallow-water regions of the Great Lakes (up to 20-meters deep).

**References:** Shuchman, R.A., C.N. Brooks, M.J. Sayers, G. Meadows, L. Jenkins, M. Auer. 2011. Determining the Feasibility of Mapping and Monitoring the Extent of *Cladophora* in the Laurentian Great Lakes with Multi-Scale Remote Sensing. Final Report for NASA ROSES Feasibility grant # 065453268, 26 pgs. Submitted to the Journal of Great Lakes Research, 2012.



# NASA Second Online Air Quality Course Reaches Federal and State Agencies Across 7 states and the Caribbean

*Ana Prados, University of Maryland Baltimore & NASA GSFC*

**Highlight** – Second online course on air quality applications of NASA Earth Science reached federal, regional, and state agencies from **7 states** in the mid western and central US and the Caribbean. The course was conducted live, one hour per week over a five week period from Feb 1 to March 7 with voluntary homework assignments and NASA instructor feedback. This course was a pre-requisite for air quality regulatory agency staff participating in a NASA hands-on course held in March 2012, for states in the Great Lakes region. Online NASA instruction enabled end-users to gauge the relevance of NASA resources to their environmental management activities and the potential benefit of subsequent NASA in person hands-on course(s). Workshop modules were video and audio recorded and the presentations are publicly available at <http://airquality.gsfc.nasa.gov>. The course was conducted by Richard Kleidman and Pawan Gupta.

**Relevance** – Met the needs of end-users in the mid western and south-central U.S, to learn about available NASA products and their potential relevance to air quality forecasting, long range transport of air pollution, and air quality modeling. The workshop also built basic skills on image access and interpretation. As a result of this online course, the project has received letters of interest from agencies in Texas and Oklahoma who would like to further their expertise in NASA air quality remote sensing applications.

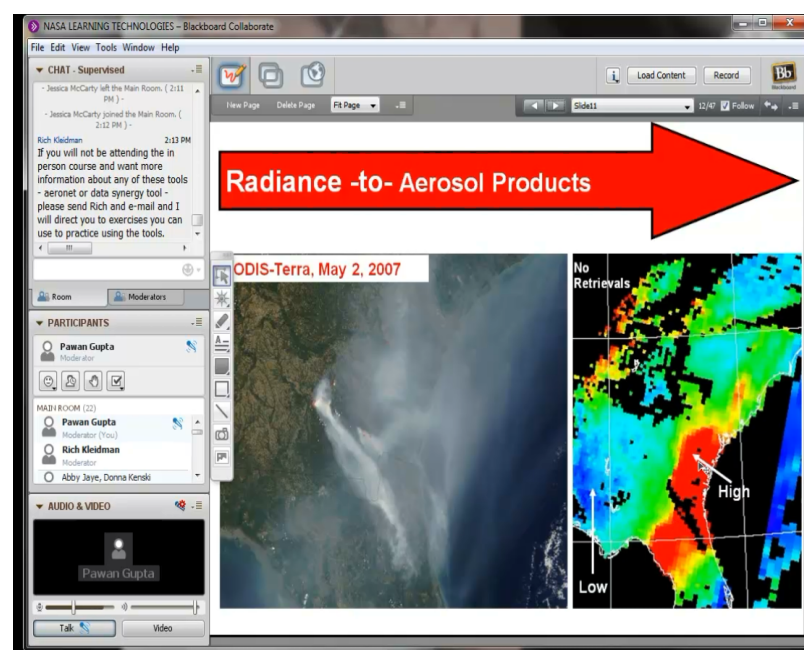


Figure 1: NASA training slide as viewed by end-users taking the online course. The interface provides visual and audio connectivity. Attendees can interact with the instructor via chat (upper left) or by asking questions in turn. The course was attended by the Lake Michigan Air Directors Consortium (LADCO), Minnesota Pollution Control Agency, Michigan Department of Environmental Quality (DEQ), Wisconsin Department of Natural Resources, Idaho DEQ, Oklahoma DEQ, Texas Commission of Environmental Quality, Indiana Department of Environmental Management, US Environmental Protection Agency (EPA) Region 5, Michigan Tech Research Institute, Jamaican Ministry of Housing and Environment, and the Jamaican National Environment Planning Agency.

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Primary Partners:  
Lake Michigan Air Directors Consortium

**Project Summary:** Provide NASA remote sensing technical workshops that build the skills to use NASA Earth Science imagery, tools and applied research for air quality applications.

**Earth Science Products:** Aerosol optical depth from OMI, MODIS, and MISR; nitrogen dioxide, ozone and formaldehyde from OMI; carbon monoxide from AIRS to help end-users engaged in surface air quality monitoring and regional model assessment, among other potential applications.

**Technical Description of the Images:** Example of two NASA aerosol products that can be used to detect smoke plumes, as viewed by course attendees using Blackboard online software. The top left hand panel enables interactive chat/questions by course attendees, the lower left panel shows a list of current course attendees.

**Application to Decision Making:** Improved ability to monitor ground level air quality and assess health impacts, particularly in regions where in-situ monitor data are currently absent. Improved ability to detect and monitor the long range transport of atmospheric aerosols due to fires and dust storms. Access to NASA OMI trace gas products facilitates regional air quality model evaluations by air quality agencies in the mid western U.S.

**Capability building:** NASA led lectures and feedback on homework assignments built skills on access and visualization of NASA aerosol and trace gas products. The course also built awareness of the range of NASA products and tools available for air quality applications. In 2012, surveys will be sent to course attendees to measure changes in NASA data utilization as a result of NASA workshops.

**Scientific Heritage:** N/A

**References:** Prados, Ana I., Connecting NASA Science to Policy Through Capacity Building, NASA Education and Public Outreach Seminar, NASA GSFC, January 19th, 2012.

# SERVIR Analyses Identify Urban Expansion in Landslide Prone Areas and Forest Cover Change

*Dan Irwin, Marshall Space Flight Center*

**Highlights:** In Guatemala, SERVIR analyses using Landsat data identified urban expansion in the protected area “Cerro Lux” which is susceptible to landslides due to a nearby geologic fault and steep slopes. According to satellite images, urbanization in the area has increased over 700% in the past 25 years. This information was featured in Guatemala’s largest newspaper, *La Prensa Libre*.

For the Dominican Republic, SERVIR developed a radar-based forest cover map using ALOS PALSAR data. The analysis showed an 8 percent increase in forest between 2003 and 2011. This was used as part of the Ministry of Forest Resources report on the nation’s forest cover.

**Relevance:** Using satellite imagery for land cover analysis provides timely, cost-efficient studies of land that otherwise are beyond the limited budgets of many developing countries. SERVIR provides a key role facilitating images, training, and analysis like these to help governments in developing nations monitor and manage natural resources.

There is an increased need for carbon sequestration to combat climate change. This increase in Forest Cover in Dominican Republic is great news. The usefulness of NASA products and the accessibility of these products facilitated by SERVIR/CATHALAC to make this type of key surveillance possible is remarkable.

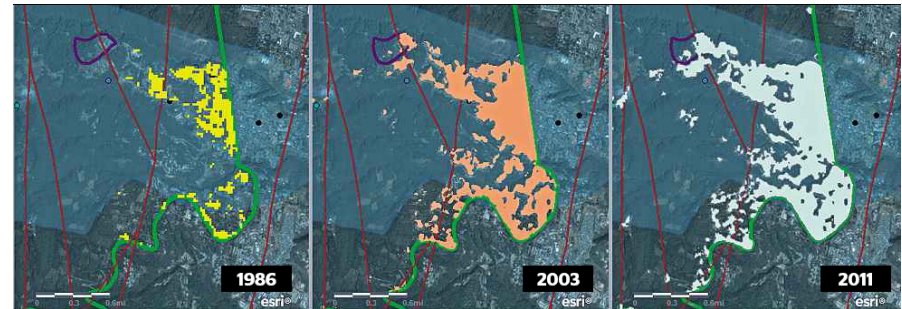


Figure 1. Shaded time-lapse photographs of Guatemala’s “Cerro Lux” region since 1986 show an increase in housing over an area vulnerable to landslides.



Figure 2. Engineer Manuel Cerrano, Vice-Minister of Forest Resources, presents his ministry’s report on forest cover in the Dominican Republic based on SERVIR-developed products.

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**Project Summary:** In Guatemala SERVIR provided imagery to the Guatemalan government used to evaluate areas susceptible to landslides.

In the Dominican Republic, the Ministry of Forest Resources used SERVIR-developed analyses based on satellite imagery to show that forest cover in that island nation has increased 8 percent between 2003 and 2011. Forests now cover 39.7 percent of the island nation. This forest growth contrasts with many Central American and Caribbean nations, where forests are being clear-cut for other uses. The forests were observed using satellite-based land cover maps from **Landsat, ALOS PALSAR and Google Earth images.**

**Earth Science Products: Landsat 5, ALOS PALSAR**

**Technical Description of the Images:**

*Guatemala:* Shaded time-lapse satellite images show Guatemala's "Cerro Lux" region since 1986. The images reflect an increase in housing over an area susceptible to landslides.

*Dominican Republic:* Engineer Manuel Cerrano, Vice-Minister of Forest Resources, presents his ministry's report on forest cover in the Dominican Republic.

**Application to Decision Making:**

Due to cracks in some areas in Cerro Lux, several homes were evacuated. Guatemala authorities declared the affected area as "high risk" since the cracks were widening by more than 2 cm (0.8 inches) per day.

The largest source of carbon emissions in Latin America comes from land use change. This increase in forest cover in Dominican Republic is crucial for carbon sequestration to combat climate change and to minimize land degradation. The usefulness and accessibility of these products was facilitated by SERVIR.

**Scientific Heritage:** These images are part of the ongoing support NASA and the U.S. Geological Survey provide for Earth observation via satellite to the international communities.